REMARKS

The Examiner's Office Action of December 18, 2002 has been received and its contents reviewed. Applicants would like to thank the Examiner for the consideration given to the above-identified application and for indicating that claim 2 contains allowable subject matter.

By the above actions, claim 1 and 2 have been amended, and new claims 19 and 20 have been added. Accordingly, claims 1, 2, 3, 4, 19, and 20 are pending for consideration. In view of these actions and the following remarks, reconsideration of this application is now requested.

Before turning to the detailed Office Action, Applicants would like to point out that the specification has also been amended, as shown above, to correct a translation error. Particularly, the phrases "an etching speed for silicon oxide film is about one tenth of an etching of for silicon" has been corrected to read as "an etching speed for silicon oxide film is about one hundredth of an etching of for silicon". Priority document JP 2000-117502 of this application recites "one hundredth". Should the Examiner require an English translation of the priority document as support for the correction, Applicants would prepare and submit an English translation.

Referring now to the detailed Office Action, claims 1, 3, and 4 stand rejected under 35 U.S.C. §103(a) as unpatentable over Jain et al. (U.S. Patent No. 6,180,533 – hereafter Jain). Consequently, claim 2 is objected as dependent on a rejected base claim. These rejection are objection are respectfully traversed at least for the reasons provided below.

In order to clarify the presently claimed invention, Applicants would like to discuss the conventional dry etching method and its associated problem.

In a case where a trench for isolation were formed in a silicon substrate by using, for example, the conventional dry etching method, etching would be halted halfway, which would leads to the problem in which the trench for isolation having a desired isolation depth would not be formed, as explained in the prior art drawing of Fig. 14 of the present specification.

In studying the reason for this etch-halting-phenomenon, the inventors of the present invention observed the following:

After the silicon substrate is placed in the chamber of the dry etching apparatus, the process gas including oxygen is introduced into the chamber. Then, once the plasma is generated from the process gas by applying the source power, the ions (halogen ions) functioning as an etching species and the oxygen radicals are generated. At this time, the oxygen radicals and an exposed portion of the silicon substrate react with each other to form a thin silicon oxide film on the silicon substrate. In this state, even if the ions in the plasma are drawn into the silicon substrate with application of the bias power, since the silicon oxide film having an etching speed of one hundredth or less of the etching speed for silicon is formed on the silicon substrate, etching performed with respect to the silicon substrate hardly proceeds. This observation is described in page 10, line 8 to page 11, line 7 of the present specification.

The invention of the amended claim 1 is based on the above observation so as to overcome the etch-halting-phenomenon. Specifically, in a case where etching is performed with respect to a material to be etched containing silicon by using the dry etching apparatus having the dual power source, the application of the bias power is initiated to generate plasma before oxidation proceeds at the surface of the material containing silicon. This prevents the situation in which the drawing of the ions from the plasma into the material containing silicon is inhibited by an oxide film formed on the surface of the material containing silicon, as well as prevents a halfway halt in dry etching performed with respect to the material containing silicon. This advantage is disclosed in page 19, line 22 to page 20, line 7 of the present specification.

On the other hand, Jain teaches "an etching for forming a trench having top and bottom corners rounding on a silicon substrate, and using a dry etching apparatus which provides for separate power control of a plasma generation source and a substrate biasing device". Jain completely fails to recognize and disclose the etch-halting-phenomenon. Hence, Jain also fails to disclose the time changes of each power and the timing of each power applied as recited in the present specification (e.g. Fig. 2) and in the pending claims.

In other words, Jain completely fails to disclose how to specifically control the source power and bias power to prevent etch-halting due to the oxidizing of the substrate.

Moreover, Jain merely discloses supplying a process gas composed of chlorine and oxygen to a chamber in which the silicon substrate is provided, and initiating etching of the silicon substrate using source power and bias power.

Applicants respectfully submit that a features of the present invention resides in the application of the bias power is initiated to generate plasma before oxidization proceeds at the surface of the material containing silicon, as recited in amended claim 1. Hence, before oxidizing the surface of the material containing silicon, the ions in the plasma generated by the application of the bias power can be drawn into the material containing silicon by the application of the bias power, as disclosed in page 36, line 25 to page 37, line 8 of the present specification. In other words, in the present invention, the etching of the material containing silicon is substantially initiated by the application of the bias power.

The reasons for initiating the etching of the material containing silicon by applying the bias power are as follows:

For example, after supplying the process gas composed of chlorine and oxygen to the chamber in which the material containing silicon is provided, the bias power is applied and then plasma including chlorine ions and oxygen radicals are generated. At this time, the electric field generated by the application of the bias power accelerates the chlorine ions toward the material containing silicon. Hence, since the accelerated ions reach the material containing silicon before the oxygen radicals, which moves randomly, etching is initiated by the chlorine ions before the oxygen radicals oxidize the material containing silicon. This explanation can be found in, e.g., page 38, lines 2-16 of the present specification.

Applicants respectfully assert that Jain completely fails to disclose initiating etching by generating plasma by the application of bias power as recited in claim 1.

The requirements for establishing a *prima facie* case of obviousness, as detailed in MPEP § 2143 - 2143.03 (pages 2100-122 - 2100-136), are: first, there must be some suggestion or motivation, either in the reference themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference to combine the teachings; second, there must be a reasonable expectation of success; and, finally, the prior art reference (or references when

combined) must teach or suggest all of the claim limitations. As Jain is deficient, as discussed above, its application in a §103(a) rejection would be improper.

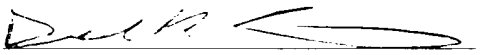
Claim 2 has been amended to include all the features of claim 1.

New dependent claims 19 and 20 have been added to further complete the scope to which Applicants are entitled. New claim 19 reflects the above amendment to the specification. Since "one hundredth" is a maximum value, the value less than one hundredth is also applicable.

In view of the amendments and arguments set forth above, Applicants respectfully request reconsideration and withdrawal of all the pending rejection and objection.

While the present application is now believed to be in condition for allowance, should the Examiner find some issue to remain unresolved, or should any new issues arise, which could be eliminated through discussions with applicants' representative, then the Examiner is invited to contact the undersigned by telephone in order that the further prosecution of this application can thereby be expedited.

Respectfully submitted,



Donald R. Studebaker
Registration No. 32,815

NIXON PEABODY LLP
8180 Greensboro Drive, Suite 800
McLean, VA 22102
(703) 770-9300

MARKED UP VERSION

IN THE SPECIFICATION:

Page 10, fourth paragraph, please replace with:

--Next, as shown in FIG. **15C**, the ions **88** in the plasma **87** are drawn into the silicon substrate **80** with application of the bias power. However, since the silicon oxide film **90** has been formed on the silicon substrate **80** as an object to be etched and an etching speed for the silicon oxide film is about one ~~tenth~~ hundredth of an etching speed for silicon, etching performed with respect to the silicon substrate **80** hardly proceeds.--

IN THE CLAIMS:

1. (Amended) A dry etching method using a dry etching apparatus having a dual power source capable of independently controlling source power for generating a plasma in a chamber and bias power for drawing ions from the plasma into an object to be etched in the chamber, the method comprising the steps of:

placing a substrate having a member containing at least silicon exposed thereat in the chamber;

introducing a process gas containing at least oxygen into the chamber in which the substrate has been placed; and

performing etching with respect to the member by generating a plasma of the process gas with application of the source power and drawing ions from the plasma into the member with application of the bias power,

the step of performing etching with respect to the member including the step of generating the plasma by initiating the application of the bias power before oxidization proceeds at a surface of the member.

2. (Amended) ~~The method of claim 1,~~ A dry etching method using a dry etching apparatus having a dual power source capable of independently controlling source power for generating a plasma in a chamber and bias power for drawing ions from the plasma into an object to be etched in the chamber, the method comprising the steps of:

placing a substrate having a member containing at least silicon exposed thereat in the chamber;

introducing a process gas containing at least oxygen into the chamber in which the substrate has been placed; and

performing etching with respect to the member by generating a plasma of the process gas with application of the source power and drawing ions from the plasma into the member with application of the bias power,

wherein the step of performing etching with respect to the member includes the step of initiating the application of the bias power before initiating the application of the source power.